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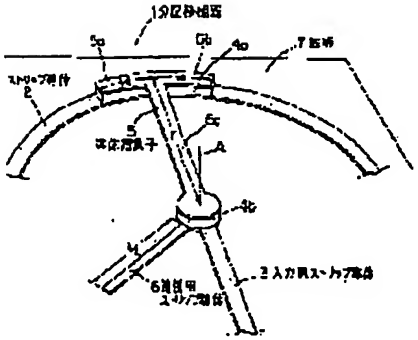

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(54) **DISTRIBUTION PHASE SHIFTER**

(57)Abstract:
PURPOSE: To reduce the number of components and to enhance the reliability in comparison with separate configuration for power distribution and phase shift by miniaturizing the distribution phase shifter and making reduction in weight and facilitating the manufacture while adopting the same configuration for the power distribution and phase shift.
CONSTITUTION: Circular-arc shaped sliding parts 5a, 5b are slid along the output side strip conductor 2 for which the both ends of the annulus ring having an opening are output terminals through an insulator 4a. A high frequency signal inputted from an input side strip conductor 3 is distributed in both directions of the output side strip conductor 2 via an arm 5c at the sliding parts 5a, 5b through the insulator 4a with a phase in

response to the rotation angle of the arm 5c and they reach the output terminals.

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CLAIMS

[Claim(s)]

[Claim 1] the conductor characterized by providing the following -- the distribution phase shifter which is equipped with a sliding child, enables rotation of the nose of cam of the aforementioned arm section around the center of the radius of curvature of the aforementioned annulus ring, and is characterized by making an insulator intervene between the aforementioned output side strip conductor and the circular sliding section and between the aforementioned input-side strip conductor and the arm section The output side strip conductor which used nothing the shape of an annulus ring which the part opened, and used ends as the outgoing end. The input-side strip conductor by which the end was positioned at the center of the radius of the aforementioned annulus ring. The circular sliding section which has the almost same radius as the radius of the aforementioned annulus ring. The arm section which has the almost same length as the radius of the aforementioned annulus ring perpendicularly extended toward center of curvature from the center of this sliding section.

[Claim 2] The distribution phase shifter according to claim 1 characterized by adding the strip conductor for impedance compensation to a part of aforementioned input-side strip conductor.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the distribution phase shifter into which the phase of the distributed signal is continuously changeable while being able to perform power distribution of a RF signal. The variable-phase feeder system which can change the beam tilt angle (directivity) of array antennas continuously using this distribution phase shifter can be constituted.

[0002]

[Description of the Prior Art] In order to change the beam tilt angle of array antennas, changing the length of the cable which supplies electric power to each array-antennas element in the RF signal distributed with the power distribution unit, and changing the phase distribution of the high frequency

current to which electric power is supplied by array antennas by this is performed.
[0003] When it was going to change the amount of phase shifts by the feeder system using such a cable, for example the feeder system was being installed in the outdoors, the water-proofing section was removed, the cable was demounted from the connector, it had to exchange for the cable with which length is different, or the cable itself had to be cut and shortened, and work time-consuming [of performing anchoring and water proofing of a connector again] had to be done.
[0004] Moreover, in order to change the beam tilt angle of array antennas, it supposes that the length of a cable is the same and what inserted the phase shifter between a power distribution unit and array antennas is used. In the feeder system using this phase shifter, if it is going to change a phase in a continuous or fine pitch, many switches and cables will be required and it will become what has a big size and big cost. And since the aforementioned switch has a Mechanical contact, by secular change, it may start a poor contact and causes an intermodulation and noise generating.
[0005] Then, the purpose of this invention is solving an above-mentioned technical problem and offering the distribution phase shifter into which a phase's is continuously changeable according to the easy structure reliability's being high.
[0006]
[Means for Solving the Problem] The distribution phase shifter according to claim 1 for attaining the aforementioned purpose The output side strip conductor which used nothing the shape of an annulus ring which the part opened, and used ends as the outgoing end, The input-side strip conductor by which the end was positioned at the center of the radius of the aforementioned annulus ring, It has a sliding child. the conductor containing the arm section which has the almost same length as the circular sliding section which has the almost same radius as the radius of the aforementioned annulus ring, and the radius of the aforementioned annulus ring perpendicularly extended toward center of curvature from the center of this sliding section -- Rotation of the nose of cam of the aforementioned arm section is enabled around the center of the radius of curvature of the aforementioned annulus ring, and an insulator is made to intervene at least between the aforementioned output side strip conductor and the circular sliding section and between the aforementioned input-side strip conductor and the arm section.
[0007] The aforementioned distribution phase shifter may add the strip conductor for impedance compensation to a part of input-side strip conductor (claim 2).
[0008]
[Function] the RF signal which was inputted from the input-side strip conductor according to the composition of the claim 1 aforementioned publication -- a conductor -- it is transmitted to a sliding child and distributed to the both directions of an output side strip conductor through an insulator in the sliding section, and since it results in an outgoing end, respectively, power distribution can be performed Moreover, since the position of the aforementioned sliding section and the distance to both the outgoing ends of an output side strip conductor are decided by the angle of rotation of the arm section, they can change the position of the aforementioned sliding section, and the distance to both the outgoing ends of an output side strip conductor by rotating the arm section. Therefore, the phase contrast of the RF signal which appears in both the outgoing ends of an output side strip conductor can be adjusted freely.
[0009] Moreover, according to invention of a claim 2, the electrostatic capacity which an input-side strip conductor has between groundings can be compensated, and adjustment can be taken.
[0010]
[Example] The accompanying drawing which shows an example below explains in detail. Drawing 1 is the perspective diagram of the distribution phase shifter 1 concerning an example. The distribution phase shifter 1 installed the long and slender input-side strip conductor 3 and the output side strip conductor 2 in a circle by which the part was opened on the dielectric substrate 7, and arranges the end of the circle configuration of the input-side strip conductor 3 at the center (A shows a medial axis) of the annulus ring of the output side strip conductor 2. Furthermore, the strip conductor 6 for impedance compensation of length lambda / 2 (lambda expresses wavelength) strength is branched from the input-side strip conductor 3 in the end of the circle configuration of the aforementioned input-side strip conductor 3. The strip conductor 6 for impedance compensation is an inductive thing for compensating the electrostatic capacity produced between the edge of the input-side strip conductor 3, and grounding. moreover, the conductor of an anchor form -- the sliding child 5 was formed and the end section (portion which will connect with a cable if it compares and says) of main shaft (henceforth the "arm section") 5c of an anchor is arranged possible [rotation] around the medial axis A of the aforementioned annulus ring The length of the portions (henceforth the "sliding section") 5a and 5b which slide on a top, the portion 2, i.e., the output side strip conductor, which is in charge of the hook of right and left of an anchor, is right and left with every [4 /

lambda/], respectively. and the high dielectric constant insulators 4a and 4b which are the insulating materials of common RF electric wires, such as the poly ethylene etc. fluoride, -- a conductor -- the sliding child 5, the input-side strip conductor 3, and a conductor -- it is made to intervene between the sliding child 5 and the output side strip conductor 2, respectively

[0011] The width of face of a conductor is chosen so that the characteristic impedance of the input-side strip conductor 3 may be set to 50 ohms, and the width of face of a conductor is chosen so that the characteristic impedance of the output side strip conductor 2 may be set to 100 ohms. the RF signal inputted from the input-side strip conductor 3 according to the aforementioned structure -- high dielectric constant insulator 4b -- minding -- a conductor -- it is combined with the sliding child's 5 arm section 5c, and results in the sliding sections 5a and 5b of right and left at a nose of cam through this And it is combined with the output side strip conductor 2 through high dielectric constant insulator 4a in the sliding sections 5a and 5b of these right and left. Give parts for some inductance to aforementioned arm section 5c, and it is made to resonate with a part for the reactance by the high dielectric constant insulators 4a and 4b, and is made to take impedance matching. equivalent, since it means that the parallel monotonous transmission line insulated by high dielectric constant insulator 4a was formed in the sliding sections 5a and 5b of the aforementioned right and left and the length of each transmission line is chosen as lambda/4 -- --like -- the center section of the sliding sections 5a and 5b -- a conductor -- it means that the sliding child's 5 arm section 5c and the output side strip conductor 2 were connected

[0012] a conductor -- since it means that the output side strip conductor 2 with a characteristic impedance of 100 ohms was connected to 2 parallel, the impedance which looked at the output side strip conductor 2 from the sliding child's 5 arm section 5c is set to 50 ohms Therefore, the impedance by the side of I/O is in agreement. the propagation wavelength of the output side strip conductor 2 -- the radius of lambda epsilon and an arm -- r -- carrying out -- a conductor -- only the angle theta made the left rotate the sliding child 5 from a central position -- then, output phase delta L of the left output side strip conductor 2 Output phase delta R of the output side strip conductor 2 of the delta L =(2 pi / lambda epsilon) r theta right It is set to delta R =-(2pi / lambda epsilon) r theta.

[0013] therefore -- the angle which fills theta=lambda epsilon delta / 4pir to realize fixed phase contrast delta using this distribution phase shifter 1 -- a conductor -- what is necessary is just to transfer the sliding child 5 4 distribution variable-phase feeder system is equipped with the three aforementioned distribution phase shifters 1 (it is called the 1st, the 2nd, and 3rd distribution phase shifter), and those connection circuit diagrams are shown in drawing 2 . That is, the edge 11 of the input-side strip conductor 3 of 1st distribution phase-shifter 1a serves as the receiving end, and the ends of the output side strip conductor 2 of 1st distribution phase-shifter 1a in a circle are connected with the edge of the input-side strip conductor 3 of the 2nd and 3rd distribution phase shifters 1b and 1c, respectively. Furthermore, the ends of the output side strip conductor 2 in a circle of 2nd distribution phase-shifter 1b are connected to the electric supply edges 12 and 13, and the ends of the output side strip conductor 2 in a circle of 3rd distribution phase-shifter 1c are connected to the electric supply edges 14 and 15, respectively.

[0014] 3 when you want to give output phase contrast to terminals 12, 13, 14, and 15 with fixed inclination in the above 4 distribution variable-phase feeder system -- delta, delta, -delta, and -3delta -- the case where he wants to obtain the output of a phase -- the conductor of 1st distribution phase-shifter 1a -- a sliding child -- the conductor of the 2theta, the 2nd, and 3rd distribution phase shifters 1b and 1c -- only theta should rotate a sliding child, respectively Thus, performing four equipartitions of the power of an input RF signal, 4 distribution variable-phase feeder system of the aforementioned example can change the electric supply phase of each terminal continuously, and can change continuously the beam tilt angle of array antennas to which electric power was supplied by this. Moreover, since a sliding portion does not perform metallic contact, it can prevent generating of noise and generating of an intermodulation by sliding.

[0015] Next, how to take impedance matching is explained. If two or more steps of multi-distribution variable-phase feeder systems are constituted using the aforementioned distribution phase shifter 1, since the characteristic impedance of the output side strip conductor 2 increases according to the number of stages, it is hard coming to take the phase matching in an output side. Therefore, the following technology is used in order to adjust the impedance of an input side and an output side.

[0016] In drawing 3 , the 50-ohm line L1 is used for an input side, and the impedance transformer L2 of length lambda / 4 is inserted. What is necessary is just to select the impedance of an impedance transformer L2 to 1(25x50)/2 =35ohm. In drawing 4 , the 100-ohm line was used for the output side strip conductors L3 and L6, and the impedance transformers L4 and L7 of length lambda / 4 are connected. What is necessary is just to select the impedance of impedance transformers L4 and L7 to 1(50x100)/2 =70ohm.

[0017] As mentioned above, although this invention has been explained based on an example, this

invention is not limited to the aforementioned example. For example, you may also choose as 3lambda besides lambda/4 / 5lambda [4 and]/4, etc. the length of the sliding sections 5a and 5b of the right and left in which the parallel monotonous transmission line insulated by high dielectric constant insulator 4a was formed. In addition, it is possible to give change various in the range which does not change the summary of this invention.

[0018]

[Effect of the Invention] Since a distribution phase shifter can be constituted using a stripline etc. as mentioned above according to the distribution phase shifter according to claim 1, small lightweight-ization can be attained and manufacture becomes easy. Moreover, since power distribution and a phase shift can be performed with the same composition, part mark decrease compared with carrying out separately, and it is high unreliable. Furthermore, since there is no metal contact, starting a poor contact etc. decreases.

[0019] Moreover, if a variable-phase feeder system is constituted using the aforementioned distribution phase shifter two or more, it is very effective as a feeder system of array antennas with the need of changing service areas, such as an antenna of a mobile communications base station, at any time. Since according to the distribution phase shifter according to claim 2 the electrostatic capacity which adds the strip conductor for impedance compensation to a part of aforementioned input-side strip conductor, and an input-side strip conductor has between groundings can be compensated and adjustment can be taken, loss of distribution can be prevented.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

Drawing-1. It is the important section perspective diagram of the distribution phase shifter concerning an example.

Drawing-2. It is the connection diagram of the variable-phase feeder system constituted with three distribution phase shifters.

Drawing-3. It is the connection diagram of the distribution phase shifter which adjusted the impedance of an input side using the impedance transformer.

Drawing-4. It is the connection diagram of the distribution phase shifter which adjusted the impedance of an output side using the impedance transformer.

[Description of Notations]

1 Distribution Phase Shifter

2 Output Side Strip Conductor

3 Input-Side Strip Conductor

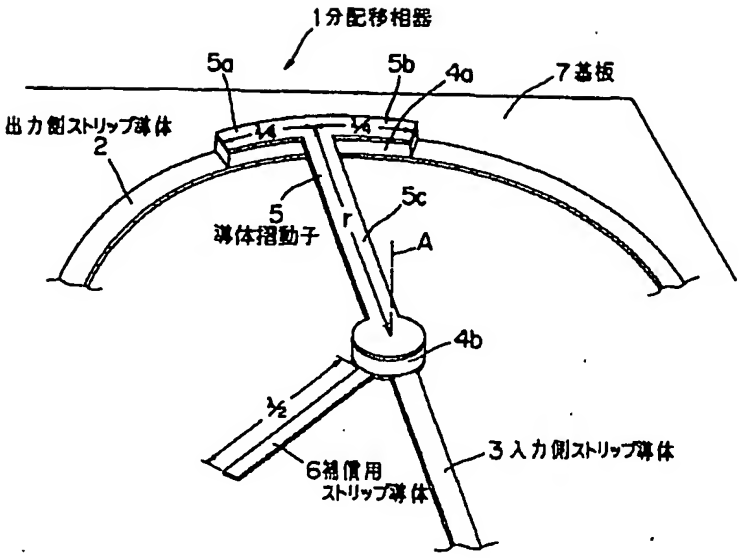
4a, 4b Quantity dielectric constant insulator

5 Conductor -- Sliding Child

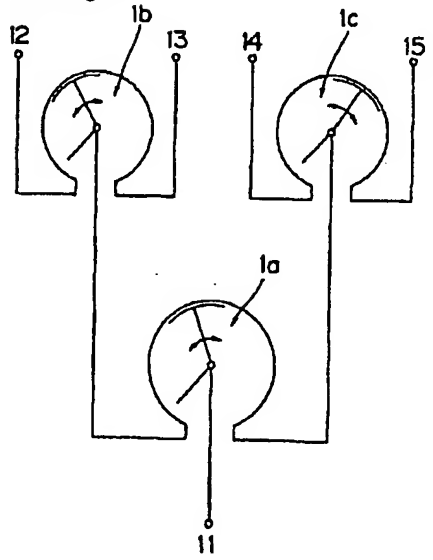
6 Strip Conductor for Impedance Compensation

DRAWINGS

Drawing-1



Drawing-2



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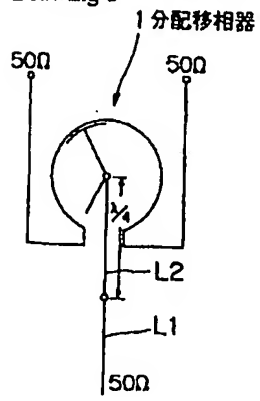
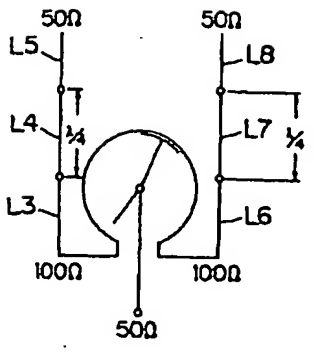


Drawing-4


50Ω
50Ω
L5
L8
L4
¼
L7
¼
L3
L6
100Ω
100Ω
50Ω